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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 08/893,917  
Filing Date: July 11, 1997  
Appellant(s): LITTAU ET AL.

\_\_\_\_\_  
William L. Shaffer  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed August 2, 2010 appealing from the Office action mailed March 26, 2010.

**(1) Real Party in Interest**

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The following is a list of claims that are rejected and pending in the application:

Claims 22-24, 27, and 28

**(4) Status of Amendments After Final**

The examiner has no comment on the appellant's statement of the status of amendments after final rejection contained in the brief.

**(5) Summary of Claimed Subject Matter**

The examiner has no comment on the summary of claimed subject matter contained in the brief.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The examiner has no comment on the appellant's statement of the grounds of rejection to be reviewed on appeal. Every ground of rejection set forth in the Office action from which the appeal is taken (as modified by any advisory actions) is being maintained by the examiner except for the grounds of rejection (if any) listed under the subheading "WITHDRAWN

REJECTIONS.” New grounds of rejection (if any) are provided under the subheading “NEW GROUNDS OF REJECTION.”

**(7) Claims Appendix**

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant’s brief.

**(8) Evidence Relied Upon**

US 5018479 A	Markunas; Robert J. et al.	05-1991
US 5788778 A	Shang; Quanyuan et al.	08-1998

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

Claims 22-24 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shang; Quanyuan et al. (US 5788778 A) in view of Markunas; Robert J. et al. (US 5018479 A). Shang teaches a method (column 4, lines 23-63; column 6, lines 13-23) of removing residue from a substrate processing chamber (10; Figure 1; column 4, lines 4-15), said method (column 4, lines 23-63; column 6, lines 13-23) comprising the steps of: forming a plasma remotely (46; Figure 1; column 4, lines 40-53) with respect to said chamber (10; Figure 1; column 4, lines 4-15), said plasma including a plurality of reactive radicals; forming a flow of said reactive radicals traversing toward said chamber (10; Figure 1; column 4, lines 4-15); forming a nonplasma diluent gas flow (32,34; Figure 1; column 4, lines 23-31), mixing said flow of said reactive radicals and said diluent gas flow at a mixing location (“T” location at 33) downstream of a location (where “57” is detailed) of forming said flow of said reactive radicals and anterior to said chamber (10; Figure 1; column 4, lines 4-15) to form a gas-radical mixture; and flowing said

gas-radical mixture into said chamber (10; Figure 1; column 4, lines 4-15) to remove residue from within said chamber, wherein each step of the method occurs without a wafer in said chamber (10; Figure 1; column 4, lines 4-15) - claim 22. Applicant's amended claim requirement is believed to be taught by Shang. According to Shang (column 1; lines 24-37), his plasma deposition system is "repeatedly" used for the implied plasma assisted deposition process (column 1; lines 5-15). As such, the deposition of a material film on a substrate, when a substrate is in the chamber (column 1; lines 20-23), *defines* Shang's "repeated use" of column 1, line 27. Shang then goes on to state that *after* Shang's "repeated use" the chamber's interior is cleaned as discussed above and below with respect to the pending claims. As a result, the Examiner believes that Shang implies the *absence* of a wafer *during cleaning*, and not during "repeated use", because the substrate must be present for Shang's process to perform as intended during the "repeated use". Further, the presence of a substrate *during* Shang's cleaning and deposition conflates such processes already distinguished by Shang (column 1; lines 24-30).

Shang further teaches:

- i. The method (column 4, lines 23-63; column 6, lines 13-23) as recited in claim 22 wherein said flow of reactive radicals and said gas flow are established to maintain a pressure within said chamber (10; Figure 1; column 4, lines 4-15) below one torr (column 5, lines 8-13), as claimed by claim 23
- ii. The method (column 4, lines 23-63; column 6, lines 13-23) as recited in claim 22 wherein said reactive radicals comprise atoms associated with a reactive gas, with said reactive gas being selected from a group consisting of  $\text{NF}_3$  (column 5, lines 8-13), dilute  $\text{F}_2$ ,  $\text{CF}_4$ ,  $\text{C}_2\text{F}_6$ ,  $\text{C}_3\text{F}_8$ ,  $\text{SF}_6$ , and  $\text{ClF}_3$ , as claimed by claim 24

- iii. The method (column 4, lines 23-63; column 6, lines 13-23) as recited in claim 22 wherein said chamber (10; Figure 1; column 4, lines 4-15) has components therein, with a subset of said radicals in said gas-radical mixture reacting with said components creating a residue (column 6, lines 13-23) and further including the step of exhausting said residue, with a rate at which said residue is exhausted depending upon a rate of said diluent gas flow, as claimed by claim 27. When the structure recited in the reference is substantially identical to that of the claims, claimed properties or functions are presumed to be inherent (In re Best, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977); MPEP 2112.01).

Shang is not specific in teaching that the nonplasma diluent gas flow comprises at least one of an inert gas or a reduction gas (hydrogen as reducing gas; column 5, lines 1-5), “as a gas used during deposition” (column 4, lines 21-22) – claim 22.

Markunas teaches a similar remote plasma apparatus (Figure 2; column 6; lines 8-48) including a plasma feed (14; Figure 2; column 6; lines 8-48) and a hydrogen “carrier gas”, as reducing gas, nonplasma (18<sub>1</sub> - “carrier gas feed” Figure 2; column 6; lines 8-48) feed.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to add hydrogen to Shang’s “nonplasma” diluent gas feed as taught by Markunas.

Motivation to add hydrogen to Shang’s “nonplasma” diluent gas feed as taught by Markunas is for “moderating the gas phase chemistry” as taught by Markunas (column 8, lines 45-50).

Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shang; Quanyuan et al. (US 5788778 A) and Markunas; Robert J. et al. (US 5018479 A). Shang and Markunas are discussed above. Shang further teaches “user-selected flow rates” (column 4, lines 53-63). Shang and Markunas do not teach the method (column 4, lines 23-63; column 6, lines 13-23; column 6,

lines 32-39) as recited in claim 22 wherein said diluent gas flow travels at a first rate and said flow of said reactive radicals travel at a second rate with a ratio of said first rate to said second rate being at least 2:1, as claimed by claim 28.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the relative flow rates of Shang's gas sources.

Motivation to optimize the relative flow rates of Shang's gas sources is for "achieve optimum of performance for a particular system" as taught by Shang (column 6, lines 32-39). It would be obvious to those of ordinary skill in the art to optimize the operation of the claimed invention (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980); In re Hoeschele, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969); Merck & Co. Inc. v. Biocraft Laboratories Inc., 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied, 493 U.S. 975 (1989); In re Kulling, 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990), MPEP 2144.05).

#### **(10) Response to Argument**

Applicant states:

“

The Office Action is wrong, however, in stating that Shang teaches mixing the flow of reactive radicals with a diluent gas at "a mixing location downstream of a location of forming said flow of said reactive radicals and anterior to said chamber to form a gas-radical mixture" as required by claim 22.

“

In response, the Examiner will paraphrase the above claimed elements consistent with his interpretation, Applicant's specification, and the Examiner's application of Shang: mixing the

flow of reactive radicals with a diluent gas at a mixing location. The mixing location being downstream of another location of forming said flow of said reactive radicals. The mixing location being anterior to said chamber to form a gas-radical mixture. Thus consistent with Applicant's disclosure, there are two claimed "locations" – 1. a location of "forming said flow of said reactive radicals" and 2. a mixing location. The claimed locations are also spatially ordered *in the direction of flow* as "a location of forming said flow of said reactive radicals", followed by "a mixing location", and finally the claimed chamber. Thus, gas originating from the location of "forming said flow of said reactive radicals" would flow along the piping and would then encounter the mixing location. After the mixing location the gases would then encounter the claimed chamber. This interpretation is entirely consistent with Applicant's Figure 3 where the Examiner identified 318 as a location of "forming said flow of said reactive radicals" and 322/320 as a "mixing location".

In context, the Examiner's application of the Shang reference is:

“

...mixing said flow of said reactive radicals and said diluent gas flow (32,34; Figure 1; column 4, lines 23-31) at a mixing location (“T” location at 33) downstream of a location (where “57” is detailed) of forming said flow of said reactive radicals and anterior to said chamber (10; Figure 1; column 4, lines 4-15) to form a gas-radical mixture

”

Thus, as with Applicant's Figure 3, Shang's Figure 1 also clearly teaches the two claimed "locations" – 1. a location of "forming said flow of said reactive radicals" (where “57” is detailed) and 2. a mixing location (“T” location at 33). Shang's locations are also spatially

ordered *in the direction of flow* as “a location of forming said flow of said reactive radicals” (where “57” is detailed), followed by “a mixing location” (“T” location at 33), and finally the claimed chamber (10; Figure 1). Thus, gas originating from the location of “forming said flow of said reactive radicals” (where “57” is detailed) would flow along the piping and would then encounter the mixing location (“T” location at 33). After the mixing location the gases would then encounter the claimed chamber (10; Figure 1).

Applicant states:

“

Shang also teaches that a diluent gas (referred to in Shang as a “minor carrier gas”) can be added to the remote plasma clean process to aid in the transport of the activated species formed in remote plasma chamber 46 to the substrate processing chamber 10. Col. 4, line 64 to col. 5, line 8. Shang teaches that the diluent gas is added prior to the remote plasma chamber as shown by gas supply 44 in the figure above.

“

In response, the Examiner notes that Applicant's above statement completely ignores the Examiner's specific Application of Shang whereby the cited diluent gas is recognized by the Examiner as Shang's sources 32,34; Figure 1; column 4, lines 23-31. Further, the Examiner notes that the claimed “diluent<sup>1</sup> gas” can be any gas that is an “inert gas or a reduction gas”. The Examiner's broadest reasonable interpretation is guided by the referenced dictionary definition and the fact that Applicant's claims *do not* accord any specific chemical identity, other than

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<sup>1</sup> *adj* 1. serving to dilute; diluting. <http://dictionary.reference.com/browse/diluent>

“inert gas or a reduction gas”, to the claimed diluent gas. Thus Applicant’s selection of Shang’s source 44 as the claimed “diluent gas” does not address the Examiner’s applied rejection.

With reference to Applicant’s above statements, Applicant continues:

“

Moreover, combining Markunas with Shang does not make up for this deficiency. Markunas pertains to a method for growing epitaxial silicon, germanium and diamond layers on a substrate.

“

In response, the Examiner only finds Shang as unspecific with respect to “teaching that the nonplasma diluent gas flow comprises at least one of an inert gas or a reduction gas (hydrogen as reducing gas; column 5, lines 1-5), “as a gas used during deposition” (column 4, lines 21-22) – claim 22.” Likewise, Markunas is applied as teaching a similar remote plasma apparatus (Figure 2; column 6; lines 8-48) including a plasma feed (14; Figure 2; column 6; lines 8-48) and a hydrogen “carrier gas”, as reducing gas, nonplasma (18<sub>1</sub> - “carrier gas feed” Figure 2; column 6; lines 8-48) feed. See above.

Applicant states:

“

As an initial matter, Markunas has absolutely nothing to do with removing unwanted deposits from substrate processing chamber or any form of a remote plasma chamber clean process.

“

In response to applicant’s argument that Markunas is nonanalogous art, it has been held that a prior art reference must either be in the field of applicant’s endeavor or, if not, then be reasonably pertinent to the particular problem with which the applicant was concerned, in order

to be relied upon as a basis for rejection of the claimed invention. See *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). In this case, Markunas is both in the field of applicant's endeavor (remote plasma delivery and mixing plasma and non plasma gas upstream of a reactor in the semiconductor manufacturing art) and is reasonably pertinent to the particular problem with which the applicant was concerned:

Compare Applicant's CVD cleanliness concerns in specification page 2, lines 11-23 with Markunas (column 13; lines 24-53):

“

In any type of epitaxial process the order and cleanliness of the starting surfaces are of paramount importance. This is especially true in any low temperature epitaxial process where adsorbed atoms may not have enough mobility unless the energy is provided by some other source other than thermal....

“ (emphasis added).

Applicant states:

“

Second, the manner in which Markunas and Shang have been combined smacks of impermissible hindsight and is generally contrary to the teaching of the references. The Section 103 rejection of claims 22-24 and 27-28 in view of Shang and Markunas is based on the following two premises set forth in the Office Action: (1) that a person of skill in the art would seek to add molecular hydrogen discussed in Markunas as the diluent gas used during the remote plasma clean process disclosed in Shang; and (2) that the molecular hydrogen from Markunas would be added to Shang via the deposition gas source 32 and mixed with radicals from the remote plasma clean

gas at intersection 33 downstream of the remote plasma source 46 instead of being introduced directly into remote plasma source 46 via diluent gas source 44 as specifically taught by Shang. The Office Action's logic underlying each of these premises, both of which must be relied upon to reach the Section 103 rejection, is faulty as discussed below.

“

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

Applicant states:

“

The Office Action states that a person of skill in the art would be motivated to "add hydrogen to Shang's 'nonplasma' diluent gas feed as taught by Markunas for 'moderating the gas phase chemistry' as taught by Markunas (column 8, lines 45-50)." The section of Markunas relied upon for this assertion, however, discusses adding molecular hydrogen to a diamond epitaxial growth process so that the hydrogen serves as a source of nucleation for the deposition reaction and so that it moderates the gas phase chemistry promoting higher saturation of CH<sub>x</sub> radicals. Col. 8, lines 43-49. Nothing in either Markunas or Shang suggest that either of these issues is at all relevant to a remote plasma chamber clean process or that it a person of skill in the art would

find it desirable to modify the surface chemistry of a chamber clean process as concluded in the Office Action. Obviousness cannot be established by combining the teaching of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination. Absent sufficient and proper motivation for the combination, a prima facie case of obviousness cannot be established.

“(emphasis added)

In response to applicant's argument, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Applicant states:

“

...the Office Action has not established why the combination of Markunas and Shang would add the hydrogen diluent gas taught by Markunas to the clean gas in Shang from the deposition gas side of the Shang chamber (deposition gas 32) instead of from diluent gas 44 as specifically taught by Shang.

“

In response, the Examiner has already provided motivation discussed by Markunas - motivation to add hydrogen to Shang's “nonplasma” diluent gas feed as taught by Markunas is for “moderating the gas phase chemistry” as taught by Markunas (column 8, lines 45-50). It is further noted that Shang's application of plasma source gases (52, 54; Figure 1) is for cleaning as discussed above, and said cleaning process is done between *deposition* process utilizing Shang's

deposition gases 32, Figure 1. Thus, a person of ordinary skill in the art at the time the invention was made would find Markunas's motivation *for adding* hydrogen as an aid in deposition as beneficial for "moderating the gas phase chemistry" as taught by Markunas (column 8, lines 45-50).

Applicant states:

“

Adding a diluent to Shang at a location other than that taught by Shang is contrary to its teaching and no motivation has been provided as to why a skilled artisan would contradict the teaching of Shang on this issue. The motivation the Examiner has provided for the combination, to "modify the surface chemistry" is irrelevant to the issue of the location at which diluent is introduced.

“

In response the Examiner's grounds for motivation, as taught by Markunas, is no where referenced as "modify the surface chemistry". The Examiner specifically cited Markunas who teaches that the addition of hydrogen is beneficial for "moderating the gas phase chemistry" as taught by Markunas (column 8, lines 45-50). As such that both Markunas and Shang teach plasma deposition processes, the control of gas phase chemistry would be considered a result-effective variable lending to film quality control and reproduction.

Applicant states:

“

Markunas teaches that molecular hydrogen can be introduced anterior to a remote plasma chamber by introducing it directly into the substrate processing chamber. See col. 7, lines 53-56 and col. 8, lines 18-22 noting that hydrogen is introduced into the chamber through gas dispersal

ring 18; see also Fig. 2 showing gas dispersal ring 18 within the deposition chamber). Thus, even if Markunas and Shang are combined in the manner done so in the Office Action, the combination would mix the reactive radicals and diluent directly in the chamber and not result in mixing reactive radicals with a diluent between the remote plasma chamber and substrate processing chamber as required by claim 22.

“

In response, the Examiner has not applied Markunas in view of Shang and instead has applied Shang in view of Markunas whereby the claimed orientation of piping discussed above is clearly taught by Shang. Indeed, Markunas injects hydrogen directly into his chamber *to influence his deposition process and not a cleaning process*. Thus, a person of ordinary skill in the art would find the control of the deposition process in Markunas via “moderating the gas phase chemistry” as beneficial in Shang's deposition process.

#### **(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Rudy Zervigon/

Primary Examiner, Art Unit 1716

Art Unit: 1716

Conferees:

/Parviz Hassanzadeh/

Supervisory Patent Examiner, Art Unit 1716

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